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(54) Abstract Title
Wrapping bales in composite material

(57) A wrapping material 10 for agricultural bales is composed of a polymeric sheet 11 with a reinforcing mesh 12 bonded or fused to at least one surface thereof, the reinforced sheet being capable of sticking to itself when wound and overlapped about a bale. In use, the baling material 10 is wound around a mass of hay, or other such material to be made into a bale, by more than one turn and thus overlapped on itself thereby binding the bale together. In the case of grass to be subjected to the ensiling process, the bale comprising the compacted mass bound with the wrap 10 is overwrapped with multiple turns of stretched wrap (40, figure 5) film so as to provide an air-tight covering for the grass. The reinforcing mesh 12 may be a polymeric material. The composite material may comprise such a mesh 12 sandwiched between two polymeric sheets 11, or a single sheet 11 sandwiched between two layers of mesh 12.

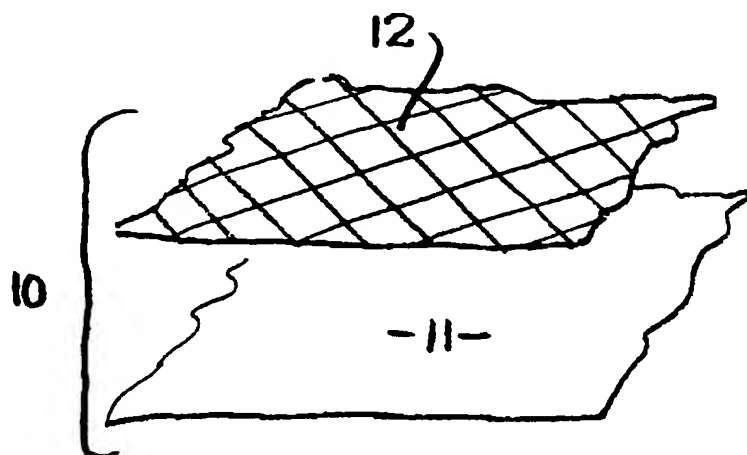


FIG. 2

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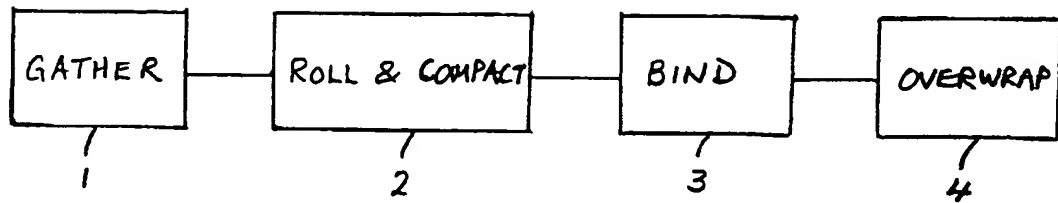


FIG. 1

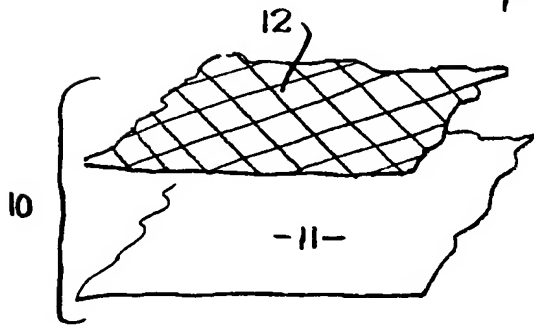


FIG. 2

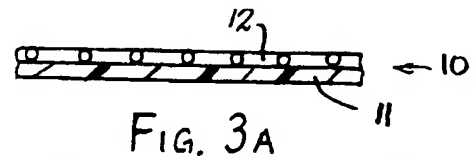


FIG. 3A

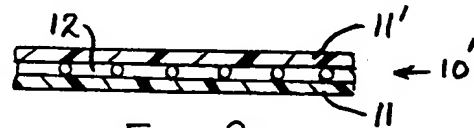


FIG. 3B

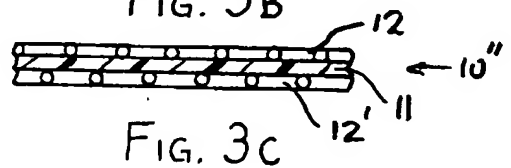


FIG. 3C

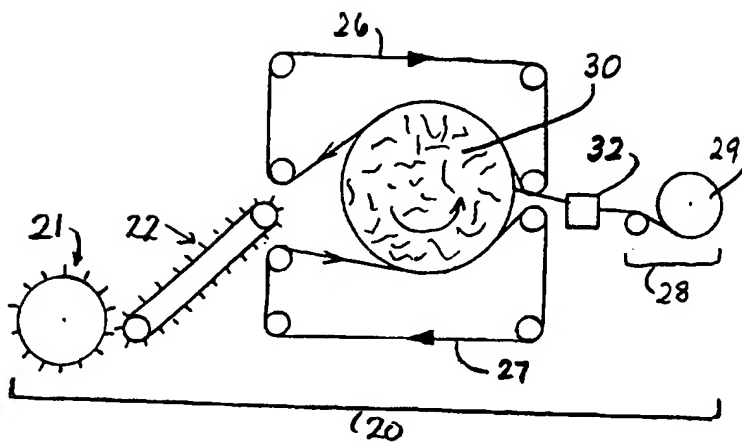


FIG. 4

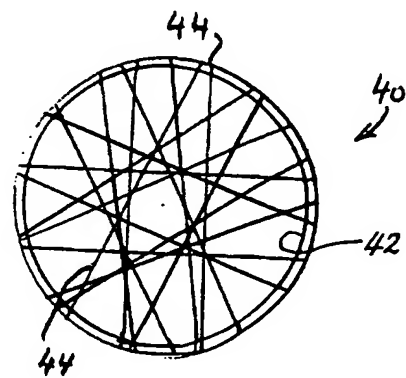


FIG. 5

BALING AGRICULTURAL PRODUCTS

This invention relates to improvements in baling agricultural products.

More particularly, the invention concerns new ways and processes for baling such products as straw and grass, new apparatus adapted therefor, and uses of particular new materials for baling.

It is commonplace for agricultural products such as straw and grass to be baled mechanically for storage until ready for use, e.g. as fodder. Baling machinery is known for this purpose.

Typically, the bulk agricultural products are resting on the ground after mowing or harvesting. A baling machine gathers up the material and converts it into compressed bales, of generally cylindrical form, by feeding it between paired, rotating belts. The machine secured the bales using baling twine or baling nets. Subsequently, the bales may be enclosed in bags or wrapping film.

In the course of baling, the agricultural material is tightly compressed, but after securing with twine or baling netting to some extent it relaxes and expands. This can result in various practical problems. e.g. if the material has to be enclosed in bags or wrapping film. The use of netting is also problematic in terms of its cost, and its

facile handling in and by the machine.

Straw bales are often partially enveloped in plastics film sleeves or wraps to protect them from the weather. Grass bales are totally enclosed in bags, or complete film wraps, to permit a natural ensilage process to proceed.

Given that the bales will ultimately be partially or completely wrapped with film, such as stretch film, it might be thought desirable, and perhaps economically feasible, to dispense with baling twine or netting, and to rely solely on the film to enclose and hold the bales together. So far as is known, this desirable objective has not been a practical proposition.

It will be appreciated that film used for wrapping agricultural bales eventually becomes scrap, once the bales are consumed. This places severe cost constraints on the film that can be employed. Film strong enough on its own to hold compressed bales together against their natural tendency to relax and expand would be prohibitively expensive, even if it existed.

Moreover, from my own experience, attempts to use available agricultural wrapping films in a baling machine will be beset with practical problems. Such films will not withstand the rigorous conditions inside a baling machine. They will perforate and tear. Quickly, they will jam the machine, leading to unacceptable production down-time as

jams are cleared.

Up to now, therefore, accepted wisdom has been that bales always need securing with conventional twine or netting before discharge from a baling machine, and before wrapping in bags or film.

In consideration of the foregoing, I have conceived a new composite material for use in producing agricultural bales, the material being suitable not only to maintain the bales' integrity, but also to form a sleeving suitable e.g. for protecting straw against weathering. The composite material will also reduce film usage, in the case of bales of grass needing complete, air-tight enveloping for ensiling.

The present invention provides a composite baling material for agricultural use, and the use thereof as a bale-securing medium in the production of bales of agricultural products, wherein the said baling material comprises a polymeric sheet with a reinforcing mesh bonded or fused to one surface thereof, the reinforced sheet being capable of sticking to itself when wound about a bale and overlapped upon itself.

The reinforced sheet can stick to itself by stiction (friction) or electrostatic forces, in the manner that cling film sticks to itself, by self-adhesion, or thanks to a coating of an adhesive material on the sheet.

The polymeric sheet can be of any material commonly used in wrapping goods, such as polyethylene. It desirably is formulated with additives which confer chosen properties on the composite material. Such additives can include U-V protective agents to guard against degradation of the film by UV radiation. The sheet can be black wrapping film, which includes absorbents of actinic radiation for protecting the agricultural product from light-induced degradation.

The reinforcing mesh can be woven or non-woven. It will normally be made of a polymeric material compatible with the polymeric sheet, to enable the mesh and sheet to bond or fuse securely to one another. The mesh could be made for instance from NYLON.

Preferably, from the viewpoint of economy, the composite baling material consists of two layers only, i.e. the polymeric sheet and the reinforcing mesh.

The composite material could however be a sandwich structure if necessary, depending e.g. on strength needs. Thus, it could consist of a central core layer of polymeric film, with reinforcing mesh bonded or fused to both surfaces of the polymeric film. Alternatively, the composite material could consist of a central reinforcing mesh layer bonded or fused on opposite sides to two polymeric film layers.

The composite baling material could be a multi-layer structure including polymeric film layers of different chemical constitutions and one or more reinforcing mesh layers.

The reinforcing mesh by its nature strengthens the polymeric sheet. So, sheet of thinner gauge than is normally used as stretch film in wrapping bales can be used. Equally, the polymeric sheet reinforces the mesh and enables that to be of thin gauge. Routine trial and experiment will enable the addressee to select suitable polymeric sheet and mesh materials, and their respective gauges.

The composite baling material may be uniaxially or biaxially stretched and heat set.

Also according to the present invention, there is provided a bale of agricultural product, such as straw or grass, wherein the product is in a compressed, generally cylindrical form and is held together by a web of composite baling material as defined above, the web extending about the periphery of the compressed product, overlapping upon itself, and sticking to itself.

By way of example, the bale has two or more turns of the web about the compressed product.

If the baled product is grass requiring ensiling, each bale will be enclosed in a sealed bag, or air-tightly

overwrapped as is known with stretched wrapping film. A benefit of using the composite baling material is that it will reduce by about one half the amount of overwrapping film normally needed to enclose a conventionally-formed bale, which is held together with baling twine or netting.

According to another aspect of this invention, there is provided a method of baling an agricultural product, such as grass or straw, wherein loose product is gathered, rolled and compressed into a compacted mass of generally cylindrical form, and is wrapped in a web of composite baling material as defined above, the web being wound about the circumferential periphery of the compacted mass, overlapped upon itself, and stuck to itself, thereby to form a completed bale.

According to still another aspect of the invention, there is provided an agricultural baling machine, including means for gathering or receiving loose agricultural product such as straw or grass, means for rolling and compressing it into a compacted mass of generally cylindrical form, and a dispenser of a web of composite baling material as defined above, the machine being operable to apply a length of the web about the circumferential periphery of the compacted mass to overlap the web upon itself and for the web to stick to itself, thereby forming a completed bale.

It is contemplated that the composite baling material

will usually be stretched as it is dispensed and applied to the bale being formed. It may be stretched lengthwise, widthwise or both lengthwise and widthwise. Film dispensing apparatuses capable of such dispensing and stretching actions are known and commercially available.

It is expected that thanks to this invention, agricultural bales of conventional size may be readily produced at a rate of the order of 60-120 bales per hour.

The several aspects of this invention will now be explained by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a flow chart illustrating steps of the method according to the invention;

Fig. 2 is a schematic illustration of the component parts of a composite baling material according to the invention;

Figs. 3A to 3C schematically illustrate three embodiments of the composite baling material according to the invention;

Fig. 4 diagrammatically illustrates a baling machine adapted to perform the method according to the invention; and

Fig. 5 illustrates a bale of grass overwrapped airtightly in stretched wrapping film.

Agricultural produce such as straw or grass which

has been cut and deposited on the ground is baled, and optionally overwrapped by the method illustrated in Fig. 1. The first step 1 is to gather the product from the ground and the second step 2 is to accumulate the product, roll it and compact it into a generally cylindrical mass. The final step 3 is to bind the compacted cylindrical mass into a finished bale, so it will retain its form for further processing and/or until needed. Further processing may include an optional fourth step 4 of bagging the bale or overwrapping it with stretched wrapping film.

The method is distinguished over conventional baling methods, which use baling twine or netting in binding step 3, in that it makes use of a novel binding or bale securing medium. Exemplary bale securing media are shown in Figs. 2 and 3A to 3C, to which reference is now directed.

The new bale securing medium is a composite material 10 comprising a polymeric sheet component 11 and a reinforcing mesh component 12, integrally bonded or fused together face-to-face. The orientation of the strands of the mesh is generally immaterial.

The sheet 11 may be thin gauge polyethylene film. The mesh 12, which may be woven or non-woven, is desirably a polymeric material compatible with the sheet 11 so as to be fusible by heat and pressure to the sheet 11. Alternatively to fusing, the sheet 11 and mesh 12 may be

adhesively bonded to one another.

Preferably, the composite material 10 consists of just the two aforesaid components and is a two-ply structure. See Figs 2 and 3A.

Another composite material 10' (Fig. 3B) is a sandwich structure consisting of a core layer of reinforcing mesh 12 between outer layers of polymeric sheets 11, 11'. The sheets 11, 11' may be of the same or different polymeric constitution.

Yet another composite material 10" (Fig. 3C) is a sandwich structure consisting of a core layer of polymeric sheet 10 between two outer reinforcing mesh layers.

Howsoever it is formed, the composite material must have the capability of sticking to itself when wrapped around the compacted cylindrical mass and overlapped upon itself. Normally, about two turns of the composite baling material 10, 10', 10" will be wrapped tightly about the periphery of the compacted mass. The material 10, 10', 10" may stick to itself like cling film, by stiction, by electrostatic forces or by means of an adhesive coating.

Desirably, the polymeric sheet 11, 11' is formulated with conventionally used additives to confer chosen properties on the sheet. Thus, it may include UV-protecting agents to guard against ultra-violet degradation of the composite material 10. It may also include

opacifying fillers, e.g. black, to protect the baled product from actinic degradation.

A baling machine 20 adapted according to this invention is schematically shown in Fig. 4. The machine 20 includes a pick-up device 21 and conveyor 22 to gather agricultural product such as mown grass or straw from the ground. The conveyor 22 delivers the gathered product into a roll-forming and compacting unit 24. Unit 24 includes a pair of confronting endless belts 26, 27 which are driven by means not shown to circulate as indicated by the arrows in Fig. 4.

The baling machine is furnished with a dispenser 28 which includes a supply roll 29 of composite baling material 10, 10', 10" according to the invention. In use, when enough product has been accumulated and compacted in unit 24, baling material 10, 10', 10" is dispensed from the roll 29 and is attached to the compacted mass 30. The dispenser 28 feeds the composite material to the rotating mass 30 so that more than a single complete turn of the material is applied around the circumferential surface of the compacted mass. Usually, at least two turns of the composite material 10, 10', 10" will be wound under tension about the compacted mass 30. Once sufficient composite material has been wound about the compacted mass 30, a cutter device 32 is operated to sever the material from the

roll 29 and dispenser 28.

The composite baling material 10, 10', 10" may be tensioned by the dispenser 28, which may thus act as a stretch wrap dispenser of any known type, such as a powered stretch wrap dispenser. Alternatively, the material may be stretched as it is dragged from the dispenser 28 by the rotating compacted mass 30, the dispenser 28 including braking means acting directly or indirectly on the roll 29 or on film fed therefrom.

The finished bale thus comprises the compacted cylindrical mass of product, and the circumferential wrap of composite baling material 10, 10', 10". The bale is discharged from the baling machine when complete. The bale has a complete wrap of the material about its cylindrical surface, which will not only hold the baled product together but will protect it from the elements. The ends of the bale are not covered by the composite baling material however. In the case of straw bales, which are often stored end-to-end, the absence of any covering of the ends of the bale is quite acceptable.

In the case of grass requiring ensiling, it is necessary for the bales to be air-tightly wrapped. Bales of grass discharged from the baling machine 20 will therefore need to be enclosed in sealed bags, or overwrapped by multiple turns of stretched wrap film.

Fig. 5 diagrammatically illustrates a fully-enclosed bale 40 of grass. In this figure, 42 represents the circumferential wrap of composite baling material 10, 10', 10" which extends fully about the circumference of the bale 40 and is overlapped upon itself, and stuck to itself. 44 represents a multiplicity of turns of stretch-wrap film which completely cover not only the circumferential surface of the bale 40, but also its ends. Machines for applying an overwrap of stretch wrap film to bales are known and commercially available, and so it is deemed unnecessary to explain their operation in any detail.

The overwrapping machine may be integrated with the baling machine, whereby a single bale-processing machine is provided which is suitable for highly productive preparation of bales for ensiling.

CLAIMS:

1. A composite baling material, for agricultural use as a baling material for agricultural products, the baling material comprising a polymeric sheet with a reinforcing mesh bonded or fused to one surface thereof, the reinforced sheet being capable of sticking to itself when wound about a bale and overlapped upon itself.
2. A composite baling material according to claim 1, wherein the reinforced sheet is capable of sticking to itself by stiction or by self-adhesion.
3. A composite baling material according to claim 1 or claim 2, wherein the reinforcing mesh is a polymeric material.
4. A composite baling material according to claim 1, 2 or 3, wherein the composite material has reinforcing mesh bonded or fused to both surfaces of the polymeric sheet.
5. A composite baling material according to claim 1, 2 or 3, wherein the composite material has a sandwich structure comprising two polymeric sheets with the reinforcing mesh therebetween and bonded or fused to both

sheets.

6. A composite baling material according to claim 1 and substantially as herein described.

7. Use, as a baling material for agricultural products, of a polymeric sheet with a reinforcing mesh bonded or fused to one surface thereof, the reinforced sheet being capable of sticking to itself when wound about a bale and overlapped upon itself, and capable of holding the bale together.

8. The use according to claim 7, wherein the reinforced sheet is capable of sticking to itself by stiction or by self-adhesion.

9. The use according to claim 7 or claim 8, wherein the reinforcing mesh is a polymeric material.

10. The use according to claim 7, 8 or 9, wherein the composite material has reinforcing mesh bonded or fused to both surfaces of the polymeric sheet.

11. The use according to claim 7, 8 or 9, wherein the composite material has a sandwich structure comprising two

polymeric sheets with the reinforcing mesh therebetween and bonded or fused to both sheets.

12. The use according to claim 7, and substantially as herein described.

13. A bale of agricultural product, such as straw or grass, wherein the product is in a compressed, generally cylindrical form and is held together by a web of composite baling material as claimed in any of claims 1 to 6, the web extending about the periphery of the compressed product, overlapping upon itself, and sticking to itself.

14. A bale according to claim 13, wherein the web makes two or more turns about the compressed product.

15. A bale according to claim 13 or claim 14, which is further enclosed either by a closed polymeric bag or by multiple turns of overlapping stretched wrapping film.

16. A bale of agricultural product, such as straw or grass, according to any of claims 13 to 15 and substantially as herein described.

17. A method of baling an agricultural product, such

as grass or straw, wherein loose product is gathered, rolled and compressed into a compacted mass of generally cylindrical form, and is wrapped in a web of composite baling material as claimed in any of claims 1 to 6, the web being wound about the circumferential periphery of the compacted mass, overlapped upon itself, and stuck to itself, thereby to form a completed bale.

18. A method according to claim 17, wherein the web is wound two or more times about the compacted mass in forming the bale.

19. A method according to claim 17 or claim 18, wherein the bale is air-tightly enclosed in a closed polymeric bag.

20. A method according to claim 17 or claim 18, wherein the bale is air-tightly enclosed by multiple turns of overlapping stretched wrapping film.

21. A method of baling an agricultural product, such as straw or grass, according to any of claims 17 to 21, and substantially as herein described.

22. An agricultural baling machine, including means

for gathering or receiving loose agricultural product such as straw or grass, means for rolling and compressing it into a compacted mass of generally cylindrical form, and a dispenser of a web of composite baling material as claimed in any of claims 1 to 6, the machine being operable to apply a length of the web about the circumferential periphery of the compacted mass to overlap the web upon itself and for the web to stick to itself, thereby forming a completed bale.

23. A baling machine according to claim 22, in association with apparatus for applying multiple turns of overlapping stretched wrapping film to the completed bale, to enclose the bale air-tightly.

24. An agricultural baling machine according to either of claims 22 and 23, and substantially as herein described.



INVESTOR IN PEOPLE

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Claims searched: 1-24

Examiner: David Harness
Date of search: 22 June 2000

Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Int Cl (Ed.7): A01F 15/07; B32B 25/10, 27/12; B65D 65/38, 65/40, 75/02, 75/04.

Other: Online; WPI, EPODOC, PAJ.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB2233962 A (PENTITH)	
A	DE3525294 (POLYDRESS PLASTIC GMBH)	
A	US 4348445 (CRAIG)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.